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Damping of Plasma Modes in Ion Plasmas[1] M. AFFOLTER, F. ANDEREGG, C.F. DRISCOLL, M. ANDERSON[2], T.M. O'NEIL, UCSD — We observe damping of Langmuir modes in Mg^+ ion plasmas with different-mass ion impurities, and compare to nascent theory treating inter-species drag and bulk viscosity. The cylindrical ion plasmas have density $n \sim 10^7 \text{cm}^{-3}$, length $L_p \sim 10$cm, and radius $R_p \sim 0.5$cm in a field of $B = 3$Tesla, with plasma temperatures controlled over the range $10^{-5} < T < 1$eV. For $T \geq 0.1$eV, damping rates agree closely with Landau theory for the standing $m_\theta = 0$, $k_z = 1$ Langmuir mode at frequency $f \sim 20$kHz. The damping from $10^{-2}\text{eV} < T < 0.1$eV is not yet understood. For $T \leq 10^{-2}$eV, damping rates $10 < \gamma < 10^3$ increase with (controlled) impurity fraction, and increase with decreasing temperature as expected for collisional drag, as $\gamma \propto T^{-3/2}$. For $T < 10^{-3}$eV, a *decrease* in γ is observed; and theory must include effects of strong magnetization, ion-ion correlations, spatial isotope separation, and bulk viscosity. Additionally, the wave damping is generally dependent on *initial* amplitude at the lowest temperatures, where the wave-induced ion velocity exceeds the ion thermal velocity.

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